This chapter presents the methodology and results of EPA's analysis of the cost and economic impacts arising from the supplemental proposed rule. The first section of this chapter provides a description of the methods that were employed to determine the costs of complying with Options 1 and 2,[1] and to compute the screening-level economic impact measures employed in this analysis, while the second section of the chapter presents and describes our analytical results.

4.1 METHODS

This section describes the methodology used to calculate the costs and impacts of managing the affected mineral processing wastes under each of two primary regulatory options. The basic analytical construct used throughout this analysis is that facility operators will choose the least-cost option that is in compliance with the law. We have not, however, conducted a *dynamic* analysis that predicts shifts in types or quantities of mineral processing residues between treatment/disposal and storage/recycling/reclamation, because of important data limitations regarding the economic feasibility of recovering mineral values (metals) from these residues. Nonetheless, application of LDR treatment requirements to other hazardous wastes has in many cases induced affected parties to employ recycling and pollution prevention approaches in order to minimize the costs of regulatory compliance. EPA has every reason to believe that such responses will occur within the regulated community when today's proposed standards are promulgated. Accordingly, the results presented below should be viewed as a preliminary view of the immediate impacts of the proposed rule, rather than a prediction of long-term, profit-maximizing behavior.

To analyze each option, EPA employed a number of steps and assumptions, some of which exert a major influence on the results obtained. The following sub-sections discuss these major analytical steps.

4.1.1 Waste Management Assumptions

The costs imposed by a particular regulatory option are measured as the difference in cost between the current, or baseline, management practices and the lowest-cost alternative practice allowed under the option. In this analysis, therefore, EPA has established what it believes are the current management practices that are applied to the waste streams of interest and determined their costs. These are then subtracted from the costs of complying with the least-cost management practice allowed under both Options 1 and 2. It is important to note, however, that due to data limitations, EPA's analysis reflects static assumptions with respect to the quantities of materials being treated and disposed versus being recycled, within any given costing scenario and option. That is, increasing waste management costs (to the extent that they would be imposed by the rule) or relaxing storage requirements are not assumed to induce the operator to recycle/reclaim more and treat/dispose less. EPA recognizes that this approach may result in an overestimation of regulatory compliance costs in some cases, particularly for Option 1.

Pre-LDR Behavior (Baseline)

Because the extent to which operators of mineral processing facilities are currently treating their hazardous wastes is largely unknown,[2] EPA has performed analyses of regulatory impact using two different baselines. Under one, referred to throughout this chapter as "no prior treatment," such wastes are assumed to be managed, untreated, in unlined surface impoundments and waste piles, i.e., the practices that were

[1] As stated in Chapter 2, EPA believes that the costs of implementing Option 3 would closely approximate those of Option 2, while the costs of adopting Option 4 would impose lower costs than any of the others due to the absence of storage requirements.

[2] Recent data retrievals from EPA's Biennial Reporting System (BRS) suggest that few, if any, facilities generating the wastes examined in this RIA are managing hazardous wastes on site. At the same time, however, a number of these facilities send non-uniquely associated hazardous wastes (e.g., laboratory or vehicle maintenance wastes) to permitted off-site Subtitle C facilities.

generally in place prior to removal of these wastes from the Bevill Exclusion in 1989 and 1990. This baseline is functionally equivalent to the assumption that the regulated community is not in compliance with existing Subtitle C waste management standards. Under the other, alternative baseline, operators are assumed to be in full compliance with Subtitle C requirements. This implies that the operator has previously chosen the least-cost option for compliance, which in this case produces the following analytical assumptions: 1) corrosive and/or TC toxic wastewaters and slurries are treated (generally with lime) in tanks; and 2) TC toxic solids, sludges, and other materials are cement stabilized within 90 days of being generated, and disposed (generally on site) in a Subtitle D unit.

Fundamentally, these assumptions are based upon the amenability of mineral processing residue treatment by lime neutralization for wastewaters and slurries and cement stabilization for sludges and solids. These methods, along with high temperature metals recovery (HTMR), are part of the basis for the UTS standards.

A point of further interest and critical importance to the analysis presented below is the fact that the very same technologies can be used to treat wastes to the point of removing the hazardous characteristic(s) and to meet the UTS standards; the difference between achieving removal of the hazardous characteristic and the UTS standards is simply one of degree. While EPA's data are not sufficient to determine conclusively whether conventional tank treatment (of wastewaters) and cement stabilization (of sludges and solids) would reduce constituent concentrations to the point at which they would meet UTS, the Agency believes that the only incremental impacts would be a slight to moderate increase in reagent (lime, caustic, or cement) consumption, and a modest increase in sludge and stabilized waste generation and attendant management costs. Because these potential cost increases are likely to be both limited in their distribution and modest in magnitude (certainly as compared to the original treatment of solids and sludges), the Agency has not considered them explicitly in the primary analysis. EPA invites comment on this aspect of its analysis and its underlying assumptions.

Post-Compliance Behavior (Impacts)

The incremental impact of the Phase IV LDR standards is estimated by first predicting cost-minimizing behavior by affected facility operators that is in compliance with the provisions of each option analyzed. Again, no fundamental shifts in resource recovery patterns are examined here.

Under EPA's preferred option (Option 1), predicted impacts assuming prior treatment of wastes are limited to new costs associated with monitoring potential releases from storage piles and surface impoundments containing sludges or by-products destined for reclamation, or alternatively, moving these materials into tanks, containers, or containment buildings. These materials (and their management) are not currently regulated. Spent materials destined for reclamation would be newly de-regulated, in that they could be managed in land-based units in the absence of a RCRA Subtitle C permit. Under the prior treatment baseline, however, the operator would be assumed to manage the material in a tank, container, or building for less than 90 days, prior to reclamation or to treatment and disposal. EPA does not believe that such operators would then shift from this management practice to storage on the land, given the costs of monitoring, surface preparation of the storage unit (in some cases), and the potential liabilities associated with unit-specific corrective action.

Assuming no prior treatment of hazardous mineral processing residues, on the other hand, Option 1 would impose significant new requirements and costs. Stated simply, all non-reclaimed wastes would be assumed to be treated to UTS levels using 1) tank neutralization/precipitation for wastewaters, 2) dewatering (in some cases) followed by cement stabilization for sludge and solid materials, and 3) disposal of treatment residuals in a Subtitle D unit. Materials destined for reclamation would be managed in containers or storage buildings (solids), or managed in drums or tanks (wastewaters and slurries). The surface preparation, monitoring, and corrective action liability costs noted above would apply only to land-based storage units. As explained below, EPA's analysis suggests that this would be an inferior alternative in most cases.

Option 2 comprises a more conventional approach to application of LDR standards to newly identified mineral processing wastes. Assumed management practices would be the same as under Option 1 for all non-reclaimed wastes. In addition, materials destined for reclamation would be managed in tanks, containers, or buildings within 90 days of generation; land-based storage would be prohibited for spent materials.

Differences in estimated cost impact between the two baselines are both dramatic and simple. Under the no prior treatment baseline, the operator would be assumed to incur the expense of procuring, installing, and operating all of the necessary equipment to treat the hazardous wastes to UTS levels for the first time, or alternatively, to incur the expense of shipping the waste(s) to an off-site commercial Subtitle C treatment facility, where it would be stabilized and disposed in a Subtitle D unit. Under the prior treatment baseline, these costs would already have been incurred as the least-cost route to compliance for the operator. Thus, impacts associated with applying UTS standards would essentially be zero.

One important additional note is that the populations of interest differ somewhat between Option 1 and Option 2. As mentioned briefly above, under Option 2 and current regulations, sludges and by-products destined for reclamation are not defined as solid wastes, and therefore would be unaffected by Option 2. These recycled materials would, however, be affected by Option 1 (at least if they are managed on the land), and therefore have been included in the Agency's analysis.

4.1.2 Cost Modeling Assumptions

The application of new technologies for treating wastes often involves the procurement and installation of new capital equipment, as well as changes in periodic operating costs. Because this new equipment is used over an extended period of time (i.e., not consumed), it is necessary to allocate its procurement and installation costs over its useful operating life. The Agency addressed this issue by annualizing the initial capital costs over the operating life of the durable equipment, and adding the discounted value of the annualized initial capital costs to the annual (recurring) capital, operating, and maintenance costs associated with the technology to obtain a total annualized cost. This yields a measure of cost impact that can be compared directly with data reflecting the ability of the affected firms to bear this incremental cost (e.g., earnings, value of shipments).

To calculate the costs of managing the affected wastes under the baselines and proposed standards, EPA developed and applied cost-estimating functions. These costing functions address the capital and O&M costs associated with each technology, as well as decommissioning costs for on-site tank treatment and stabilization. These costing equations are expressed as a function of the waste generation rate (in metric tons/year). In addition, the costing functions provide a means of estimating the break-even point between off-site and on-site land disposal costs. Because of data limitations, EPA used sector-wide averages and totals for estimating the impacts of the rule. Sector-wide estimates were, however, developed on an average facility basis, so as to correctly address facility-level economies of scale.

General Approach to Developing Waste Management Costs

EPA estimated the implementation costs of the options for hazardous waste streams from mineral processing by calculating the difference between the estimated pre- and post-LDR costs.

The Agency aggregated the non-reclaimed hazardous streams by solids content, based on the assumption that a facility would not build a separate stabilization facility and on-site landfill for each individual waste stream but would instead handle all wastes requiring stabilization and disposal in common treatment and disposal units. Therefore, the Agency calculated the average facility generation rate by *sector* for hazardous waste streams containing 1 to 10 percent solids (i.e., slurries), hazardous wastes streams having greater than 10 percent solids, and hazardous wastewaters. EPA then applied the costing equations to the three scenarios to obtain minimum, expected, and maximum average facility costs for each sector. Under all three scenarios, the costing equations allowed for treatment and/or disposal on-site when a facility had sufficient quantities of waste to make on-site management an economically attractive option.

In contrast, quantities of residues destined for recycling were assumed to require segregation, so as to promote efficient resource recovery. EPA made the conservative assumption that each material to be recovered would require storage prior to reclamation, and therefore, that each would require its own storage unit. In general, pre-compliance storage under the no prior treatment baseline occurs in piles and surface impoundments, while pre-compliance storage under the prior treatment baseline and post-compliance storage under both baselines occurs in drums and tanks (wastewaters and slurries), and containers and containment buildings (for solids). As discussed more fully below, post-compliance storage outdoors in piles and surface impoundments is generally an inferior management alternative, assuming cost-minimizing behavior on the part of the affected operator.

Because of information limitations, EPA has not attempted to precisely define the point of reintroduction of recycled or reclaimed materials into the mineral production process in this analysis. The Agency's working (and simplifying) assumption is that recyclable materials could be reinserted into the mineral processing sequence at or near the point of generation. EPA recognizes that this simplifying assumption may not be accurate in all situations, particularly given the wide range in the estimated quantities of material being recycled/reclaimed across the three costing scenarios.

Development of Average Facility Costs

To determine the costs of each option and the related impacts, EPA divided the average facility generation of each potentially hazardous waste stream into the following categories: waste requiring treatment and disposal, waste requiring storage prior to recycling, and waste considered to be non-hazardous, in each costing scenario. The Agency computed the average facility generation rate of the portion of waste requiring treatment by solids content category and sector, i.e., separately for wastewaters, waste slurries with 1 to 10 percent solids, and wastes having more than 10 percent solids. The Agency repeated this totalling process for each of the three costing scenarios under both options. The average facility-level quantities of wastes, by category and sector, as well as the percentage being recycled under each scenario, are presented in Exhibit 4-1. A more detailed description of the totalling process may be found in Appendix F.

Having derived the quantity of each type of waste (wastewaters, 1-10 percent solids, and more than 10 percent solids) going to both treatment and disposal or storage prior to recycling for an average facility in each sector, EPA calculated the cost associated with each of these activities. To determine the cost of treatment and disposal, the Agency assumed that in the no prior treatment baseline, waste materials are sent to on-site disposal piles or impoundments, while in the prior treatment baseline, wastes are already being treated in accordance with the LDRs. Therefore, in both Option 1 and in Option 2, there are no costs attributed to treatment and disposal using the prior treatment baseline.

In the analysis, EPA made the following assumptions about waste treatment and disposal practices:

- Management of hazardous mineral processing wastes containing more than 10 percent solids involves non-permitted treatment followed by disposal of the stabilized mass in a subtitle D unit. Treatment consists of cement stabilization, which increases the mass of waste destined for disposal to 175 percent of the mass entering stabilization.

- Management of hazardous mineral processing wastewaters and wastes containing more than 10 percent solids involves non-permitted treatment followed by disposal of the stabilized mass in a subtitle D unit. Treatment consists of neutralization, followed by dewatering of the precipitated solids, and cement stabilization of the dewatered sludge. The precipitated mass from neutralization is 15 percent of the original waste stream, while the dewatered mass is 15 percent of the precipitated mass (or 2.25 percent of the original waste stream). Stabilization increases the mass of the dewatered sludge by 55 percent (or 155 percent of the mass entering stabilization).

These assumptions and their factual basis are documented in Appendix F.

The Agency has assumed that both pre- and post-LDR management of treated residues would occur in (primarily) on-site Subtitle D landfills, because under the prior treatment baseline assumption, the affected operators would have constructed such units to be in compliance with (i.e., avoid) pre-LDR Subtitle C waste management requirements. For low volume wastes ($\leq$ 820 metric tons solids/year or 350 metric tons liquids/year), EPA has assumed that post-compliance, the operator would send the waste to an off-site Subtitle C facility for treatment (stabilization) and ultimate disposal in a Subtitle D unit. The Agency did not include non-hazardous waste streams in the analysis, because the supplemental proposed Phase IV LDR rule will not affect those wastes.

The first step in determining the cost of treatment was to compute the quantity of waste requiring each type of treatment at an average facility in each sector, because the affected facility operator would not purchase or build separate treatment and disposal units for either each waste stream or each type of waste by solids content. S/he would instead take advantage of scale economies and co-manage similar waste types. For example, both wastewaters and wastes with a 1 to 10 percent solids content are assumed to be neutralized and dewatered in the same units, while the sludge generated from dewatering and wastes with more than 10 percent solids are stabilized in the same unit and disposed in a single Subtitle D unit. Once EPA determined the quantities of waste going to each treatment unit (accounting for volume changes brought about by each treatment step), the Agency used costing equations to determine the capital, operating and maintenance, and closure costs of each of the treatment and disposal units; these costs were then annualized and totalled. In some sectors, there was not enough waste to justify on-site treatment and disposal, so the Agency assumed the waste would be shipped off-site for treatment and disposal.

To determine the costs associated with storing wastes prior to recycling, EPA assumed that in the no prior treatment baseline, a 90 day quantity of waste to be recycled is stored in either piles on the ground or in surface impoundments. In the prior treatment baseline, EPA assumed that wastes to be recycled are stored for less than 90 days in drums or tanks if they are liquid and in drums, roll-off containers, or buildings if they have a solids content of more than 10 percent. After the LDRs go into effect, the Agency assumes that in Option 1, wastes may continue to be stored in the same manner as in the baseline, but storage piles and surface impoundments will now require groundwater monitoring. In most cases, however, cost-minimizing behavior would induce the operator to move from land-based management to storage in tanks, containers, or containment buildings. Under Option 2, prior to recycling, wastes would be stored in tanks, containers, or buildings for less than 90 days, regardless of baseline practice. Therefore, in the Option 2 prior treatment baseline, there is no change in recycling practices, and no associated costs.

To estimate the impacts of the material reclamation practices outline above, EPA used unit costs to calculate the costs associated with storing wastes in piles and surface impoundments, and developed costing functions to calculate the cost of groundwater monitoring and storage in tanks, containers, and buildings. Again, and in contrast to waste treatment operations, we determined recycling costs on a per waste stream basis, rather than a per facility basis, because it is important in many cases that the wastes to be recycled not be commingled.

The Agency added the treatment and disposal costs to the storage or monitoring costs for managing reclaimed materials to calculate baseline and post-compliance facility-level costs. In the final step, EPA multiplied the incremental LDR facility cost, computed as the difference in baseline and post-LDR costs, by the number of affected facilities to determine the incremental total sector cost.

Financial Assumptions

The costing functions incorporate the following general assumptions:

- **Operating Life**. The analysis assumes a 20-year operating life for waste management units and facilities. With a positive and even moderately significant discount rate, extending the operating life beyond this period adds complexity but little tangible difference in estimated costs.

- **Tax Rate**. Costs are estimated on a before-tax basis, so as to facilitate comparisons with available data related to predicting ultimate economic impacts.

- **Discount Rate**. The analysis uses a discount rate of seven percent, in keeping with current Office of Management and Budget (OMB) guidance.[3]

- **Inflation Rate**. The analysis is conducted in real terms and, consequently, assumes an inflation rate of zero.

Details regarding the development of the costing functions and additional assumptions that were used in computing cost impacts are provided in Appendix F.

[3] OMB, 1992. *Circular A-94*.

Corrective Action

Under Option 1, mineral processing residues stored on the land would be excluded from the definition of solid waste prior to reinsertion into a mineral processing production unit; this exclusion would be conditioned on the operator meeting certain requirements. One of these requirements is that the land-based units in which these materials would be stored would be subject to unit-specific corrective action.

Corrective action requirements for permitted units are codified in 40 CFR Part 264, Subparts F and S. In general, these requirements stipulate that the owner or operator must remove or treat in place any hazardous constituents that exceed acceptable concentration limits. EPA intends to replace the existing corrective action requirements with a more detailed regulatory program for implementing corrective action that will be codified in Subpart S of 40 CFR 264. As part of this effort, EPA has conducted significant analyses of the costs of corrective action. For this analysis, the Agency assumes that any corrective actions that must be performed would be conducted under the new Subpart S standards. Therefore, EPA is using the cost estimates developed for the proposed corrective action rulemaking to estimate the potential cost impacts of the corrective action requirements of Option 1.[4]

Not all land-based units would require corrective action under Option 1. Only those units releasing hazardous constituents to the environment in significant concentrations would be required to perform unit-specific corrective action. Drawing from previous analytical work addressing this topic, EPA estimates that approximately 45 percent of surface impoundments and 33 percent of waste piles are expected to require corrective action.[5] The surface impoundments and waste piles that are subject to corrective action might require source control, soil remediation, surface water remediation, ground water remediation, or some combination of these actions. The specific actions that would need to be taken would depend on the type and extent of contamination. The cost of performing the required actions would also depend on the type and extent of the contamination, as well as the size of the unit and the volume of material contained therein. Exhibit 4-2 below presents the estimated range of present value corrective action costs for both types of units.

The estimates presented in Exhibit 4-2 are for units at a wide range of facilities, comprising a variety of different contaminants and magnitudes of existing contamination. Therefore, these estimates may not be representative of the population of mineral processing facilities examined in this analysis. There are, in fact, only three mineral processing facilities in the sample used to develop these cost estimates; therefore, any alternative estimate that the Agency might have developed based on these mineral processing facilities alone would be subject to a higher degree of uncertainty, given the extremely small sample size.

EXHIBIT 4-2
Range of Present Value Corrective Action Costs[a]

Unit Type	Minimum	Maximum	Weighted Average[b]
Surface Impoundment	$900	$58,000,000	$1,200,000
Waste Pile	$1,000	$3,200,000	$380,000

[a] Costs are in 1992 dollars and were discounted using a 7 percent annual rate.
[b] Each facility is weighted according to size and whether the facility is a federal facility to allow extrapolation to a national universe.

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[4] The cost estimates, as well as the methodology used to develop them, are presented in the *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units, Proposed Methodology for Analysis*, ICF Incorporated, March 1993.

[5] *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units, Proposed Methodology for Analysis*, ICF Incorporated, March 1993, page 4-15.

To determine the total potential cost of corrective action under Option 1, we calculated the number of facilities that might avail themselves of the conditional exclusion under each of the three scenarios (minimum, maximum, and expected) for each waste stream. Next, we determined the type of units that would be used to manage material under the conditional exclusion at each facility.[6] Finally, we used the percentage of units expected to require corrective action discussed above and the cost estimates presented in Exhibit 4-2 to calculate the total potential corrective action cost for each stream. For the minimum scenario, we used the minimum of the range of costs, for the maximum scenario we used the maximum of the range, and for the expected scenario we used the weighted average cost per unit.

4.1.3 Economic Impact Analysis

To evaluate the significance of increased waste management costs to affected facilities and industry sectors, EPA employed simple ratio analyses to yield first-order economic impact estimates. The Agency compared sector-wide estimated regulatory compliance costs with each of three different measures of economic activity. Note that EPA did not consider the extent to which industry sectors may be able to pass on to their customers the costs of regulation.[7]

First, EPA compared regulatory costs for each sector to the estimated value of shipments from the plants in that sector. This provides a rough measure of the extent to which gross margins would be reduced by the increased waste management costs, or alternatively, the amount by which the affected commodity price would need to increase to maintain existing margins. The Agency recognizes that this approach produces only a very crude and preliminary estimate of ultimate economic impact on affected facilities. Unfortunately, however, this is the only ratio analysis for which the needed data were available for all of the industry sectors. EPA calculated the ratio of annualized incremental cost to the value of shipments for all three waste generation scenarios, and in keeping with numerous other analyses, has defined the screening level threshold for significant impact as five percent. The Agency also has selected an arbitrary, though conservative, level of ten percent as a screening-level indicator of severe potential impact.

Second, for 17 industry sectors where data were available, EPA compared estimated regulatory costs for each sector to the estimated value added by that sector. A ratio of regulatory costs to value added may be more useful in assessing regulatory impacts than a ratio of regulatory costs to shipments. In particular, a mineral processing industry (such as the primary copper industry) generally incurs substantial costs to purchase or produce the raw materials used in mineral processing activities (such as copper concentrate). The total dollar value of shipments for a mineral processing industry thus includes not only the costs of production and profit, but also the costs of raw materials. In contrast, the value added in manufacturing measures the sales revenue minus the cost of raw materials. Thus, it presents a clearer picture of the extent of economic activity at the regulated operation, and the basis on which the firm may make profits attributable to that operation. EPA obtained value added data for copper and aluminum from a Census Bureau publication.[8] The Agency obtained value added data for 15 industry sectors categorized as "primary nonferrous metals, not elsewhere classified" from the same publication, and apportioned the total value added to each of the 15 sectors according to that sector's proportion of the total value of shipments for the 15 sectors. The Agency's background calculations are provided in Table G-9 in Appendix G. For this analysis, as with the analysis based on shipments data, EPA used screening levels of 5 percent (for significant impact) and 10 percent (for severe impact).

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[6] If the waste stream is either a wastewater or contains 10 percent or less solids, we assumed that it would be managed in a surface impoundment. Otherwise, we assumed that the material would be managed in a waste pile.

[7] An industry sector's ability to pass on costs depends on two factors: (1) the elasticity of demand (if demand changes little with a change in price, industry has a greater opportunity to pass on most of the costs), and (2) the extent of the world market represented by U.S. suppliers (if U.S. suppliers represent a small portion of the world market, most of the market is unaffected by U.S. regulations and U.S. suppliers cannot pass on the costs).

[8] Bureau of the Census, U.S. Department of Commerce, *1992 Census of Manufactures, Industry Series, Smelting and Refining of Nonferrous Metals and Alloys, Industries 3331, 3334, 3339, and 3341* (Washington, DC: U.S. Department of Commerce), p. 33C-9.

Third, for six industry sectors where data were available, EPA compared estimated regulatory costs for each sector to the estimated profits of that sector. This ratio analysis permits a direct comparison of regulatory costs to profits, and indicates the maximum extent to which the regulation will reduce industry profits (if industry cannot pass on any of the regulatory costs to customers). To conduct this analysis, EPA obtained profits data for firms known to be engaged primarily or exclusively in processing a single type of mineral. The Agency obtained these data from the Disclosure on-line commercial database, for the most recent year available in the database. (The Disclosure database, in turn, contains data taken from 10-K forms that publicly-held firms must file with the Securities and Exchange Commission.) EPA based its estimate of profitability for each of the six industry sectors on the weighted average profitability of the firms in each sector for which data were available. The Agency's background calculations are provided in Table G-10 of Appendix G. For this analysis, EPA selected a screening level threshold for severe impact of 100 percent.

4.2 RESULTS

This section presents EPA's estimates of the cost and screening-level economic impacts of Options 1 and 2 of today's proposed rule. These estimates are provided in turn by option, followed by some brief comparisons between options.

4.2.1 Cost Impact Analysis Results

Option 1

Cost impacts under the prior treatment baseline are modest for most sectors; these impacts are depicted in Exhibit 4-3. These impacts are restricted in scope to waste streams, facilities, and sectors in which the new storage requirements for residues destined for reclamation would take effect. In the expected and maximum cost cases, three sectors (gold and silver, lead, and copper) would incur cost impacts in excess of $1 million annually. The copper and lead sectors would also experience impacts of this magnitude under the minimum cost scenario. A maximum of 22 sectors would experience any impacts under this option, though predicted sector-wide impacts would exceed $100,000 annually for only eleven, even under the maximum cost scenario. Estimated total industry-wide cost impacts range from about $7 million to around $18 million per year, depending upon the scenario used. This result reflects EPA's use of static waste management assumptions, i.e., no additional quantities of material are assumed to be recycled, and no currently recycled residues are assumed to be treated and disposed. The estimated impacts arise from the more stringent storage requirements that would apply to previously exempt sludges and by-products.

Under the no prior treatment baseline, cost impacts are substantial for some sectors even in the minimum cost scenario. Total estimated industry-wide cost impacts range from about $60 million to more than $365 million annually, with an expected value of about $143 million per year. These projected impacts are presented in Exhibit 4-4, while additional detail (tabulated waste type and facility-level costs) is presented in Appendix G.

Under the minimum cost scenario, the sectors experiencing the highest estimated annualized cost impacts are the titanium and titanium dioxide ($28 million), copper ($11 million), lead ($9.7 million), and zinc ($8.5 million) sectors. The remaining eight sectors experiencing impacts under this option and scenario have annualized costs ranging from essentially zero to $720,000. At the average facility level, four sectors (titanium and titanium dioxide, lead, zinc and copper) have annualized costs at or above $1 million, one (beryllium) has costs between $500,000 and $700,000, and four (rare earths, tantalum, columbium, and ferrocolumbium, selenium, and elemental phosphorus) have estimated annualized costs between $100,000 and $260,000.

Under the expected cost scenario, 30 sectors experience costs totalling about $143 million annually. Six sectors (titanium and titanium dioxide, gold and silver, copper, lead, zinc, and rare earths) have incremental waste management costs between $10 and $30 million annually, while six others have estimated annual costs between $1 and $10 million. Thirteen sectors have total cost increases of more than $1 million annually. In addition to those projected to have cost increases of this magnitude in the minimum cost case, gold and silver, molybdenum, ferromolybdenum, and ammonium molybdate, rare earths, beryllium, rhenium, antimony, pyrobitumens, mineral waxes, and natural asphalt, zirconium and hafnium, and uranium have estimated annualized cost impacts of more than $1 million. Estimated facility-level cost impacts range from less than $100 to $4.3 million. At the average facility level, seven sectors have incremental costs greater than $1 million annually; these include titanium and titanium dioxide, lead, zinc, gold and silver, beryllium, rhenium, and copper.

Under the maximum cost scenario, 31 sectors experience incremental waste management costs from implementing Option 1. The range of sector-wide impacts runs from $120 per year (for calcium) to $120 million annually (for gold and silver). Seven sectors (gold and silver, copper, titanium and titanium dioxide, molybdenum, ferromolybdenum, and ammonium molybdate, lead, rare earths, and zinc) experience impacts of more than $20 million annually, while one additional sector (beryllium) has estimated impacts between $10 and 20 million per year. A total of 21 sectors (two-thirds of the total) have projected impacts of more than $1 million annually under this scenario, while most of the remaining sectors have estimated incremental costs of more than $500,000. Fifteen sectors have average facility-level costs in excess of $1 million annually, and four (gold and silver, lead, zinc, and beryllium) have average costs of more than $5 million per year.

One interesting trend that is apparent from Exhibit 4-4 is that the range around the expected value cost impact estimate is much greater, both in absolute and in relative terms, for some sectors than for others. Another finding is that the sector-wide cost impacts are uniformly far higher for a few sectors than for most others. Both trends are related to the quantity and quality of EPA's waste generation, composition, and management practices data. With a few exceptions, those sectors for which data are relatively abundant have both higher estimated costs and lower uncertainty around the expected value than do the other sectors. This is a fundamental limitation of the analyses presented in this RIA, and should be carefully considered when drawing conclusions from the estimates presented in this document.

Corrective Action

As discussed above, Option 1 includes a provision for unit-specific corrective action for land storage of mineral processing wastes destined for reclamation or recycling. Using the methodology described in a previous section of this chapter, EPA has estimated the range of potential corrective action costs for each sector and waste stream that may be stored in land-based units prior to reclamation; detailed results of this analysis are provided in Appendix G. The estimated range of potential corrective action costs under Option 1 is very wide. This is primarily due to the wide range in EPA's pre-existing unit-specific corrective action cost estimates.

EPA believes that the predominant response to Option 1 would be to manage mineral processing residues destined for recycling or reclamation in tanks, containers, and storage buildings. Even in the absence of potential corrective action liabilities, management indoors is a more cost-effective management practice than management in land-based units in most cases. Tank storage of wastewaters and slurries is generally less costly than management in surface impoundments (depending upon the analytical treatment of sunk capital costs for existing units), and accumulation in containers is less costly than storage in piles, at least at lower generation rates. Storage of large quantities of solid materials in piles can be a cost-effective strategy, but if the uncertain nature and potentially significant costs of unit-specific corrective action are factored in, storage in containment buildings generally confers both lower risk and reduced costs.

Accordingly, the Agency believes that it is unlikely that corrective action costs would actually be incurred by a substantial number of facility operators if Option 1 is promulgated, and therefore has not formally factored corrective action costs into its estimates of the regulatory impact of this option. EPA recognizes that some facility operators might choose land storage and that their land-based storage units might at some future time release hazardous constituents such that corrective action would be required. The unit-specific cost estimates presented in Appendix G are provided to address this possibility. In terms of bounding the analysis, if one were to assume that all eligible facility operators were to employ land-based storage, EPA's analysis suggests that total annualized corrective action costs would range from approximately $4,000 under the minimum cost scenario, to as much as $610 million under the maximum cost scenario; the expected value estimate is approximately $15 million annually.

Recycling of Wastes to Beneficiation Operations

As stated above, because of information limitations, EPA has made an important simplifying assumption regarding the point of material reintroduction into the production process for those wastes being recycled and reclaimed. The Agency's assumption is that recyclable materials could be reinserted into the mineral processing sequence at or near the point of generation. Under Option 1, EPA has stipulated that wastes could be recycled to beneficiation operations without impact on the special waste status of the production unit or any wastes that it generates. The Agency has identified several wastes, in addition to those assumed to be recycled to processing operations, that could perhaps be returned to beneficiation operations. The distinctions between these two groups of wastes relate to mineral value concentrations, with higher value material reporting to processing operations, and materials with lower concentrations being returned to beneficiation operations.

The materials assumed to be amenable to recycling through beneficiation units are generated by the beryllium, cadmium, and gold and silver sectors. Recovery of these materials would have no effect in the minimum cost case, would reduce waste management costs by an estimated $4 million per year in the expected value case, and by $10 million annually in the maximum cost case.

Option 2

Cost modeling results from application of Option 2 vary substantially, just as they do under Option 1. As stated above, projected cost impacts of implementing Option 2 (conventional LDRs) under the prior treatment baseline are essentially zero, because treatment of regulated wastes (and reclamation of spent materials) would already be performed in compliance with the standards that would be established under this option.

Assuming a no treatment baseline, on the other hand, would suggest significant changes in waste management practices, with concomitant increases in waste management costs. Estimates of these costs are displayed in Exhibit 4-5. Additional details supporting these estimates are available in Appendix G. Total industry-wide cost impact estimates range from almost $52 million to just under $350 million, with an expected value of about $130 million annually.

Under the minimum cost scenario, Option 2 would affect ten commodity sectors. Incremental estimated costs at the sector level range from about $2,000 to $28 million. The sector that bears the highest total estimated incremental cost is the titanium and titanium dioxide sector ($28 million), followed by the copper sector ($8.7 million), the zinc sector ($8.3 million), and the lead sector ($4.9 million). All but one (beryllium) of the remaining sectors have estimated incremental costs of less than $500,000 annually. On a per facility basis, facilities in the titanium and titanium dioxide, zinc, and lead sectors have costs that exceed $1 million annually; average costs are less than $300,000 in five of the remaining seven sectors affected by Option 2 under this scenario.

Under the expected cost scenario, Option 2 affects 27 sectors and imposes an estimated total cost of $1 million or more annually on twelve. Under this scenario, the titanium and titanium dioxide and gold and silver sectors account for more than one-third of the industry total, with estimated annual incremental costs of $30 and $23 million, respectively. On a per facility basis, seven sectors are projected to experience average costs in excess of $1 million; these include titanium and titanium dioxide, zinc, lead, beryllium, gold and silver, rhenium, and copper.

The maximum cost scenario addressing Option 2 suggests sector-level impacts exceeding $1 million annually in 22 of 31 affected sectors. Incremental costs range from about $170,000 to $120 million annually. Under this scenario, the gold and silver sector incurs the highest incremental cost and alone accounts for more than one-third of total costs. On a per facility basis, costs range from $56,000 to more than $7 million. Of the 31 affected sectors, per facility costs are greater than $1 million in 15 sectors.

As indicated by the above discussion, the total estimated incremental costs imposed by both Options 1 and 2 increase fairly dramatically from the minimum cost scenario to the maximum cost scenario. This result is, again, a direct consequence of the range of uncertainty reflected by the three scenarios. The estimated cost implications of the two options are similar, with Option 1 costs exceeding Option 2 costs in some sectors, due to the new controls that would be established for storage units containing reclaimed/recycled wastes.

Other Options

EPA has not explicitly evaluated the costs of implementing Options 3 or 4. As stated above, however, the Agency believes that the range of cost estimates presented above addressing Options 1 and 2 provides a reasonable basis from which the costs of these alternatives could be inferred. Costs of implementing Option 3 would be slightly higher than those of Option 2, and less than those of Option 1, because only the regulatory status of reclaimed spent materials would be affected. Option 4 could also be closely approximated by Option 2, because costs of treatment and disposal of discarded materials would be the same under both options, while the costs of storage of materials for reclamation would be somewhat lower under Option 4. The Agency recognizes that adoption of Option 4 might promote additional uncontrolled storage and reclamation of mineral processing residues and less treatment and disposal, given the relative costs of these practices.

4.2.2 Economic Impact Analysis Results

As described above in Section 4.1.3, EPA conducted three ratio analyses, which compared regulatory costs to a selected financial indicator: (1) value of shipments, (2) value added, and (3) gross profits. Data were available to determine the ratio of regulatory costs to value of shipments for all 31 industry sectors affected. However, data were available for only 17 industry sectors to determine the ratio using value added, and for only six industry sectors to determine the ratio using gross profits. This section presents the results of the three analyses.

Ratio of Regulatory Costs to Value of Shipments

Under the prior treatment baseline, economic impacts expressed as a ratio of regulatory costs to value of shipments indicate that Option 1 imposes very limited impacts, while, as discussed above, Option 2 impacts are essentially zero. Option 1 would impose new storage costs on materials destined for recycling that would amount to between five and about six percent of the value of shipments for the lead sector, depending upon the costing scenario chosen. Predicted impacts on the other nine other sectors expected to be affected by Option 1 under these baseline conditions are all below two percent under each costing scenario.

Results of the screening level economic impact analysis under the no prior treatment baseline are presented in Exhibits 4-6 (for Option 1) and 4-7 (for Option 2). The discussion that follows focuses on Option 1, which has higher material storage costs for some sectors.

Under the minimum cost scenario, only one sector (selenium) is projected to experience costs that exceed five percent of the value of shipments. This sector has an estimated cost-to-value ratio of nearly thirteen percent. Four other sectors (lead, zinc, beryllium, and titanium and titanium dioxide) have estimated impacts that exceed one percent of the value of shipments.

Under the expected value costing scenario, facilities in seven sectors are projected to experience severe screening-level impacts. Pyrobitumens, mineral waxes, and natural asphalts, tungsten, cadmium, rhenium, mercury, selenium, and rare earths would be anticipated to incur costs that would exceed ten percent of the value of shipments. Five other sectors would be predicted to experience incremental waste treatment costs exceeding five percent of their respective values of shipments. These are antimony, lead, bismuth, beryllium, and tellurium. Seven other sectors are projected to experience impacts in the one to five percent range, and twelve sectors would have increased costs at less than one percent of the value of shipments.

Finally, using the Agency's maximum cost scenario, six additional sectors are predicted to experience severe cost impacts (more than ten percent of the value of shipments; these are tellurium, bismuth, beryllium, molybdenum, ferromolybdenum, and ammonium molybdate, antimony, and lead. Three additional sectors (fluorspar and hydrofluoric acid, germanium, and uranium) are projected to suffer impacts that exceed the Agency's five percent screening level. Under this scenario, seven sectors have estimated impacts between one and five percent of sales, and eight sectors have impacts below one percent.

The severity of predicted economic impact does not in all cases reflect the magnitude of increased waste treatment costs estimated in this analysis. Facilities in several sectors are projected to experience significant cost increases but are not expected to suffer serious economic impact, because of high production rates and/or because the commodities that they produce have a high unit market price. Examples include alumina and aluminum, copper, gold and silver, magnesium and magnesia from brines, titanium and titanium dioxide, zinc, and zirconium and hafnium. Plants in other sectors (e.g., calcium, platinum group metals) are projected to experience low impacts because estimated incremental waste treatment costs are relatively modest.

In contrast, the sectors that are projected to experience the most severe impacts have both moderate to high incremental waste management costs and low commodity production rates, a low commodity price, or both. Prominent examples in this category include cadmium, selenium, tellurium, tungsten, and particularly, pyrobitumens, mineral waxes, and natural asphalt. It is worthy of note, however, that several of these commodities are co-products. That is, their principal or sole source of production is another, generally much larger mineral production

Exhibit 4-6

Graphic Not Available.

Exhibit 4-7

Graphic Not Available.

operation. Consequently, while new waste management controls (and their costs) might threaten the economic viability of production of these commodities, they would generally not threaten the viability of the larger operation. This phenomenon is critically important to evaluating potential impacts on a number of sectors projected to experience significant cost/economic impacts in this analysis. Exhibit 4-8 displays the relationships between some of these sectors and their larger associated commodity production operation(s).

EXHIBIT 4-8
Relationships Among Mineral Commodity Production Operations

Affected Commodity Sector	Primary Associated Commodity
cadmium	zinc
mercury	gold
selenium	copper
antimony	lead, silver/copper
bismuth	lead, copper/lead
rhenium	molybdenum
tellurium	copper

Ratio of Regulatory Costs to Value Added

Because value added is less than shipments, the ratio of regulatory costs to value added will be higher than the ratio of regulatory costs to shipments. EPA obtained data on value added for 17 mineral industry sectors.

Results of the screening level economic impact analysis using value added data under the no prior treatment baseline are presented in Exhibits 4-9 (for Option 1) and 4-10 (for Option 2). The discussion that follows focuses on Option 1.

Under the minimum cost scenario, EPA identified five sectors with severe cost impacts (selenium, lead, zinc, beryllium, and titanium and titanium dioxide) and none with significant cost impacts. Under the expected cost scenario, most sectors had severe impacts (cadmium, rhenium, antimony, bismuth, tellurium, and germanium) and one sector with significant impacts (gold and silver). Under the maximum cost scenario, nearly all sectors had severe impacts, including gold and silver and zirconium and hafnium. One additional sector had significant impacts (platinum group metals).

EPA did not include in the value added analysis 14 industry sectors for which the Agency was not able to obtain value added data: boron, calcium, coal gas, elemental phosphorus, mercury, molybdenum, ferromolybdenum, and ammonium molybdate, pyrobitumens, mineral waxes, and natural asphalt, rare earths, scandium, synthetic rutile, tantalum, columbium, and ferrocolumbium, tungsten, and uranium.

Ratio of Regulatory Costs to Profits

Comparing regulatory costs to profits allows one to estimate how the costs of regulations will affect an industry's bottom line. Incremental costs that exceed a company's or industry's profits over an extended period will generally result in facility closures and exit from the industry in question. EPA obtained limited data on profits for six industry sectors.

Results of the screening level economic impact analysis using profits data under the no prior treatment baseline are presented in Exhibits 4-11 (for Option 1) and 4-12 (for Option 2). Under Option 1, none of the six industry sectors are projected to have severe cost impacts (defined as costs that were greater than estimated industry profits), under any of the cost scenarios. However, under Option 2, one sector (platinum group metals) is projected to have severe impacts under the expected and maximum cost scenarios. The Agency recognizes the limitations inherent in this approach, principally the likelihood that the reported gross (before tax) income for the companies comprising the sample for the six sectors examined includes earnings from activities that would be unaffected by today's proposal, and therefore, may be overestimated for purposes of analyzing the economic impact of today's proposal.